Part I. INSPECTION FUNDAMENTALS

Section 1. THE INSPECTION PROCESS

The Required Aircraft Inspections

The Federal Aviation Regulations (FARs) require the inspection of all civil aircraft at specific intervals, to assure that the aircraft's condition is equal to its original or properly altered condition with regard to aerodynamic function, structural strength, and resistance to vibration.

Inspection interval requirements are established considering the purpose for which the aircraft is used and its operating environment. Some aircraft must be inspected each 100 hours of time in service while others must be inspected only once each 12 calendar months.

The 100-hour and annual inspections require complete inspection of the aircraft at one time and a certification as to its airworthiness. Some airplanes may be inspected in accordance with a progressive inspection (FAR 91.171) or an approved inspection program (FAR 91.217) wherein portions of the aircraft are inspected according to a predetermined schedule.

The inspection requirements for aircraft, in various types of operation, are stated in FAR 91, Sections 91.169, 91.171, or Subpart D of FAR 91. The latter prescribes an inspection program for large and turbine-powered multiengine airplanes (turbojet and turboprop). If you are concerned with the inspection of a large airplane (over 12,500 pounds) or a turbojet or turbopropeller-powered multiengine airplane, you should determine the inspection requirements for that specific airplane.

The information contained in Section I of this handbook may not be directly applicable to these larger type airplanes, but the inspection techniques will be similar.

FAR 91—General Operating and Flight Rules.

Subpart C of Part 91 prescribes rules governing the maintenance, preventive maintenance, and alteration of U.S. registered civil aircraft operated within or outside the United States. (Inspection is part of maintenance.)

FAR 43—Maintenance, Preventive Maintenance, Rebuilding, and Alteration, prescribes rules governing the maintenance, preventive maintenance, rebuilding, and alteration of aircraft as well as standards for their performance.

Inspection.

Inspection is the critical visual examining, testing, measuring, and functional checking required to determine the airworthiness of the items being inspected.

> NOTE: As mentioned in the preface, the services of a certificated repair station, certificated mechanic, or the manufacturer must be utilized for all required inspections and whenever any inspection reveals a questionable condition.

Scope of Inspections.

Aircraft inspection may range from a casual "walk-around" to a detailed inspection involving complete disassembly and the use of complex inspection aids. The inspections described in this advisory circular can be made without disturbing the assembly of the aircraft except for the removal of inspection access covers, fairings, and removable cowlings.

The Habit of Inspection.

The inspection of your aircraft should become a habit. To establish the habit, begin by performing preflight inspections and work up to detailed inspections. USE the MANUFACTURER'S RECOMMENDATIONS and this handbook as a guide. Develop a system of

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inspection and use an inspection checklist that covers the complete aircraft. Once adopted, you should not deviate from the procedure. After completing a few inspections you will be surprised at how familiar you will be with your aircraft.

Inspection Intervals and Systems.

Federal Aviation Regulations require inspection of aircraft at specific intervals and that they be approved for return to service by certificated and appropriately rated personnel. The purpose of this handbook is to familiarize interested persons with general inspection techniques and to assist pilots and owners in establishing an inspection program which will supplement but NOT replace the required inspections.

The interval of your inspection should be adjusted to provide the greatest value to you considering your aircraft use and the required inspections; e.g., if you are required to have 100-hour inspections, you might want to inspect the aircraft each 25 and 50 hours. If you are required to have only annual inspections, you may wish to inspect the aircraft each 50 to 100 hours of operation. The manufacturer's service instructions will be valuable in establishing these intervals.

Historically, inspection intervals have been established on the basis of flying hours. However, if utilization is low and flying is done over the weekends, you may find it advisable to inspect a small group of items each weekend. This will spread your inspection over a period of time and reduce large demands on your time. Here are some examples of types of inspection intervals:

By hours:

- Daily preflight inspection
- Powerplant (including propeller and engine controls)—every 25 hours
- Flight control systems—every 25 hours
- Landing gear—every 50 hours
- Cabin or cockpit—every 75 hours
- Covering (fabric or metal)—every 100 hours
- Fuselage interior—every 100 hours, etc.

By calendar weeks (eight-week cycle):

- Daily preflight inspection (including propeller and engine controls)
- Powerplant—first and fifth weekend
- Flight control system—second and sixth weekend
- Landing gear—third and seventh weekend
- Cabin or cockpit—fourth and eighth weekend
- Covering (fabric or metal)—eighth weekend
- Fuselage interior—eighth weekend

This weekly inspection schedule will provide a complete aircraft inspection every eight weeks. You may wish to extend or shorten this inspection cycle.

In some cases, it may be convenient to establish a combination of both methods. Regardless of the method chosen, adhere to it faithfully. Do not assume that an item is in good condition. Make a personal inspection each time an inspection is due, according to your plan. There are many inspection items; each of which is essential.

When developing an inspection schedule for your aircraft, consideration should be given to climatic conditions, frequency and type of flight operation conducted, contemplated periods of inactivity, and type of storage facilities. A thorough review of the aircraft manufacturer's service instructions will provide many helpful suggestions on inspections. Most manufacturers provide an inspection schedule for their aircraft which can be segmented as you desire. The information in this handbook will not tell you WHEN to inspect. It will suggest WHAT should be inspected and HOW and WHERE to look for possible defects.

Be sure your plans include the time necessary to regularly inspect your aircraft. If such time cannot be included in your plans, then you should have it done by certificated personnel. When you have inspections conducted by a professional, whether they are required or supplemental in nature, you should specify exactly what inspection is to be accomplished and require the person conducting the inspection to furnish a written statement of the results.

Aircraft Logs.

"Logs," as commonly used, is an inclusive term which applies to the aircraft record "books," and to all supplemental records concerning the aircraft. These logs and records provide a history of maintenance and operation, a control for inspection schedules, data needed to properly accomplish time replacements of components or accessories, and a record of Airworthiness Directive compliance. Most Airworthiness Directive compliance is based on aircraft time-in-service, and it is a regulatory requirement that records be kept up-to-date.

Tools of Inspection.

The tools of inspection are many and varied. They range from a pocket-sized magnifying glass to a complex X-ray machine. The tools required to make a simple inspection, of the type which may be performed by the aircraft owner, are inexpensive and readily available. The following list is typical:

- eight or ten-power magnifying glass
- inspection mirror
- flashlight
- small wire brush
- dull-bladed knife
- round bristle brush and cleaning fluid (use caution when selecting cleaning fluids)
- hydrometer
- some rags
- small kit of common handtools (screwdriver, end wrenches, diagonal cutters, etc.)
- skid-proof stepladder and wheel jacks

REMEMBER

If defects are noted or suspected, have a detailed inspection done by a certificated repair station or certificated mechanic.

Section 2. PREVENTIVE MAINTENANCE

Preventive maintenance means simple preservation and the replacement of small standard parts not involving complex assemblies. It is corrective action taken before it becomes necessary to make more complex repairs. The following preventive maintenance may be accomplished by a certificated pilot, who is the owner or operator of an aircraft, not used in air carrier service.

This list comes from FAR 43, Appendix A, Major Alterations, Major Repairs, and Preventive Maintenance, paragraph (c). It reads as follows:

"(c) ***Preventive maintenance.*** Work of the following type is preventive maintenance:

(1) Removal, installation, and repair of landing gear tires.

(2) Replacing elastic shock absorber cords on landing gear.

(3) Servicing landing gear shock struts by adding oil, air, or both.

(4) Servicing landing gear wheel bearings, such as cleaning and greasing.

(5) Replacing defective safety wiring or cotter keys.

(6) Lubrication not requiring disassembly other than removal of nonstructural items such as cover plates, cowlings, and fairings.

(7) Making simple fabric patches not requiring rib stitching or the removal of structural parts or control surfaces.

(8) Replenishing hydraulic fluid in the hydraulic reservoir.

(9) Refinishing decorative coating of fuselage, wings, tail group surfaces (excluding balanced control surfaces), fairings, cowling, landing gear, cabin, or cockpit interior when removal or disassembly of any primary structure or operating system is not required.

(10) Applying preservative or protective material to components where no disassembly of any primary structure or operating system is involved and where such coating is not prohibited or is not contrary to good practices.

(11) Repairing upholstery and decorative furnishings of the cabin or cockpit interior when the repairing does not require disassembly of any primary structure or operating system or interfere with an operating system or affect primary structure of the aircraft.

(12) Making small simple repairs to fairings, nonstructural cover plates, cowlings, and small patches and reinforcements not changing the contour so as to interfere with proper airflow.

(13) Replacing side windows where that work does not interfere with the structure or any operating system such as controls, electrical equipment, etc.

(14) Replacing safety belts.

(15) Replacing seats or seat parts with replacement parts approved for the aircraft, not involving disassembly of any primary structure or operating system.

(16) Troubleshooting and repairing broken circuits in landing light wiring circuits.

(17) Replacing bulbs, reflectors, and lenses of position and landing lights.

(18) Replacing wheels and skis where no weight and balance computation is involved.

(19) Replacing any cowling not requiring removal of the propeller or disconnection of flight controls.

(20) Replacing or cleaning spark plugs and setting of spark plug gap clearance.

(21) Replacing any hose connection except hydraulic connections.

(22) Replacing prefabricated fuel lines.

(23) Cleaning fuel and oil strainers.

(24) Replacing batteries and checking fluid level and specific gravity.

(25) Removing and installing glider wings and tail surfaces that are specifically designed for quick removal and installation and when such removal and installation can be accomplished by the pilot."

Technical data for use in performing preventive maintenance may be found in the manufacturers' manuals. General data on aircraft maintenance may be obtained from the following Advisory Circulars (AC) published by the FAA. All are available from the Superintendent of Documents (Supt. Docs.) and should be ordered by the stock numbers (SN) listed after each AC.

AC 65–9A, Airframe and Powerplant Mechanics General Handbook, is designed as a study manual for persons preparing for a mechanic certificate with airframe or powerplant ratings. Emphasis in this volume is on theory and methods of application. It is intended to provide basic information about principles and fundamentals common to both the airframe and powerplant ratings. (SN 050–007–00379–0.)

AC 65–12A, Airframe and Powerplant Mechanics Powerplant Handbook, is designed to familiarize student mechanics with the construction, theory of repair, operation, and maintenance of aircraft powerplants and propellers. (SN 050–007–00373–1.)

AC 65–15A, Airframe and Powerplant Mechanics Airframe Handbook, is designed to familiarize student mechanics with construction, theory of repair, operations, and maintenance of airframe and airframe systems. (SN 050–007–00391–9.)

Advisory circulars are available either free from FAA or sold by the Superintendent of Documents. The source, ordering instructions, and current prices are listed in the FAA Advisory Circular Checklist, AC 00–2. The checklist should be consulted for current information before placing any orders. (A reference copy is available at any FAA office or GPO Bookstore.)

The checklist is published three times a year and is available free from Department of Transportation, Publications Section, M–443.1, Washington, D.C. 20590.

The Status of Federal Aviation Regulations, AC 00–44, is issued as changes require and is also available free from the above address.

Malfunction or Defect Reports (FAA Form 8330–2) are provided free of charge and with return postage paid by the FAA. They are normally preaddressed when provided, and are a convenient means of ensuring that data, required to make the report meaningful, is included.

These reports are a means by which the aviation community may interchange service information since the data received on the reports is published in numerous FAA publications, available free or on a subscription basis.

Malfunction or Defect Reports are also a data source used by the FAA in monitoring the service reliability of aeronautical products. When trends are noted which indicate possible problem areas, the FAA may alert the aviation community or initiate studies to determine the extent and exact nature of the problem.

All aircraft owners, pilots, mechanics, and non-certificated maintenance facilities are invited to participate in the program by submitting M or D Reports whenever they become aware of items that may be of interest to others. The M or D Reports, FAA Form 8330–2, may be obtained from most airport managers, maintenance facilities, or any FAA District Office.

If you have had an experience you wish to share, include in the report all information available; how the occurrence became apparent, describe the malfunction, and include model numbers, part numbers, and serial numbers.

Parts may be submitted with the report by special arrangement. Pictures, sketches, or snapshots are especially desirable. Include identification data such as make, model, and assembly name as an attachment rather than printing on the photograph. If you have any questions, or need any help, your local FAA District Office will gladly assist you.

The success of the program depends entirely on participation by the aviation public. If you have comments about the program or have a special experience or a "would you believe this" situation, send them to Federal Aviation Administration, Flight Standards National Field Office, Safety Data Branch, AFS-580, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

Section 3. THE FORCES OF ATTRITION

A Definition of Attrition.

Attrition, for the purpose of this handbook, is defined as the general wear and tear of an aircraft during its service life. The five basic sources of attrition are: weather, friction, overloads, heat, and vibration. These forces assert themselves in many ways on the entire structure of the aircraft during its life span. Persons making inspections should be familiar with the visible, measurable, or otherwise detectable effects of these forces.

Weather.

Much depends on local conditions such as heat, humidity, rain, wind, and snow. Each element, or combination of elements, has its own peculiar effect upon different parts of the aircraft. These effects are discussed briefly in the following paragraphs.

Atmospheric Moisture. The moisture content of the atmosphere is directly related to the severity of oxidation found on an aircraft. Aircraft based near large bodies of water or in areas receiving heavy rainfall are more susceptible to oxidation (rusting and corrosion) than those based in arid areas. Fabric surfaces and wood structures also decay due to atmospheric conditions.

Oxidation. This condition is caused by the chemical combination of metal and oxygen. Oxidation is called rusting when talking about ferrous materials; i.e., steel or iron. The oxidation of copper, aluminum, and other nonferrous materials is usually known as corrosion.

Rusting. Rust usually begins as a reddish discoloration on the surface and, if permitted to progress, will result in a reddish brown crustiness on the metal surface. Removal of the crust will probably reveal pitting. If pitted, the part should be examined by an experienced mechanic qualified to evaluate the extent of the damage and recommend or take corrective action.

The steel tube members of an aircraft equipped with floats should be given particularly close examination. It is possible for water to enter the interior of these members, allowing rust to form on the inside of the tubes while the exterior appears to be in good condition. The best way to check for this condition is to have small holes strategically drilled in the tubing. If water is present, it will run from the holes. It is sometimes desirable to have small pieces cut from critical tube members in order to obtain positive knowledge of the condition of the tube interiors.

CAUTION

Tests of this nature should be performed by, or under the supervision of, a certificated mechanic or repair station and entered in the aircraft records. Specialized experience and skill are required to determine where water is most apt to concentrate, and where and how to drill the tubing.

Rusting may be prevented or retarded by applying a protective coating to prohibit the atmosphere from coming in contact with the bare metal. This is usually accomplished by electrolytic plating or the application of a zinc base paint. Plating may only be accomplished by certificated personnel.

The interior of steel and aluminum structural tubing is protected by flushing with hot linseed oil, paralketone, or other corrosion inhibitors. The holes drilled for this operation are usually plugged with sheet metal screws (see CAUTION above).

Corrosion. Aluminum, magnesium, and other nonferrous metals are susceptible to corrosion whenever the protective coating deteriorates. Deterioration is accelerated whenever the coat-

ing is in contact with an eroding chemical such as battery acid, insecticide, fertilizer or defoliants. Contact between two unprotected dissimilar metals sets the stage for galvanic action and corrosion, the rate of which increases greatly in the presence of moisture, especially saltwater.

Ordinary corrosion of aluminum, magnesium, or aluminum alloy parts can be detected by watching for signs of surface flaking, pitting, or a white or grayish-white powdering. If pitting is apparent after removing the flakes or powder film, an experienced mechanic should be contacted to evaluate the damage. On aluminum and magnesium (or their alloys) surfaces that have been painted, watch for paint bubbles or blisters. These indicate corrosion under the paint. The suspected part should be cleaned to the bare metal and examined carefully.

Decay of Wood Structure. The protective coating on wood structures usually consists of high grade varnish or some type of transparent enamel. An acceptable coating will have a hard glossy appearance. Whenever and wherever the protective coating deteriorates, decay will start.

Healthy wood will splinter if probed with a dull knife point. Decayed wood will crumble or break away in chunks. Weathering of the structure is first indicated by a dull appearing surface, which means that the protective film has broken down. Be especially alert to wooden components subject to the collection of moisture and/or poor ventilation.

Decay of Fabric. The decay of fabric is somewhat similar to the decay of wood. If exposed to the elements, fabric absorbs moisture and other harmful substances unless it is protected by several applications of cellulose nitrate or cellulose acetate, liquids commonly known as "dope." When "dope" is applied, it acts to tighten the fabric and produces a hard, smooth, opaque finish. In time, this finish becomes brittle and develops cracks which expose the bare fabric to the harmful effects of ultraviolet light, dirt, oil, and mildew. The strength of the fabric decreases to below minimum str ʻh and is no longer airworthy.

The effect of decay on finished fabric surfaces can be ascertained only by testing. To determine if a test is necessary, examine the fabric surface. If the surface no longer presents a hard flexible glossy finish, is severly abraded, or cracks are present, testing is appropriate.

A manual punch test, performed by a qualified repair station or mechanic, will provide an indication of fabric strength. A conclusive test can only be done by a recognized testing laboratory, wherein fabric samples are tested under specified temperature and humidity conditions. If laboratory test facilities are not readily available, contact your local FAA inspector for information in their regard.

Since re-covering a surface is usually an expensive process, economics dictates the practice of good preventive maintenance. Washing fabric-covered surfaces with mild soap and water, at reasonable intervals, will do much to prolong the life of dope and fabric. Protection from sunlight also prolongs fabric life, since ultraviolet light is a prime factor in fabric deterioration.

Friction

Friction is described as the resistance to relative motion between two bodies in contact. Like any machine, the aircraft develops friction in hundreds of moving parts. The effect of friction on the aircraft and its components is known as wear. Wear cannot be prevented, but steps can be taken to deter its ultimate effects on the aircraft's airworthiness by proper lubrication, alignment of moving parts, and cleanliness. To better understand inspection techniques, the terms used to describe the various conditions of wear, due to friction, must be understood. They are as follows:

Abrasion is a form of wear caused by the presence of an abrasive substance between two moving parts. In the flight control system, the possibility of abrasion can be detected by a gritty, grinding sensation noticeable during operation. Landing gear joints subjected to abrasion may exhibit an uneven jerky action when in motion. Usually a black gritty substance will be noticed at any joint subjected to abrasion.